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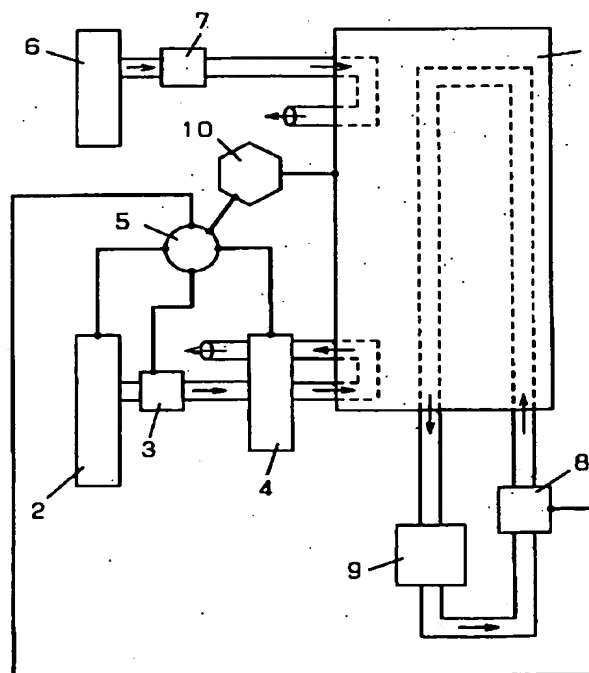
最終頁に続く

(54) 【発明の名称】 高分子電解質型燃料電池およびその運転方法

(57) 【要約】

【課題】 高分子電解質型燃料電池は、電池内部に発生する結露水で特性が低下する。

【解決手段】 燃料電池通過時における燃料あるいは酸化剤ガス圧力損失、または単セル電圧出力の時間差分値や時間微分値の絶対値を求め、これをあらかじめ定めておいた設定値と大小比較を行うことで燃料あるいは酸化剤ガスの加湿過多を検出し、電池の温度を上げる、またはガスの加湿量を下げる。



**【特許請求の範囲】**

**【請求項1】** 水素イオン伝導性高分子電解質膜と、前記水素イオン伝導性高分子電解質膜を挟む位置に配置した一対の電極とを具備した単電池を、前記電極の一方に水素を含む燃料ガスを供給排出し他方に酸素を含む酸化剤ガスを供給排出するガス供給溝を形成した導電性セパレータを介して積層し、前記単電池の冷却治具を具備した電池スタック部分、

前記燃料ガスと前記酸化剤ガスを前記電池スタック部分に供給するガス供給用マニホールドと、前記電池スタック部分に供給した前記燃料ガスと前記酸化剤ガスを排出するためのガス排出用マニホールドと、前記単電池の冷却治具に供給する冷却媒体の流量または温度の少なくとも一方を制御する電池冷却制御部、

前記燃料ガスの前記電池スタック部分への供給量制御部および前記燃料ガスの前記電池スタック部分での圧力損失測定部、または前記酸化剤ガスの前記電池スタック部分への供給量制御部および前記酸化剤ガスの前記電池スタック部分での圧力損失測定部の少なくとも一方、

前記電池スタック部分に供給する前記燃料ガスの加湿制御部、または前記電池スタック部分に供給する前記酸化剤ガスの加湿制御部の少なくとも一方を具備し、

前記燃料ガスの前記電池スタック部分での圧力損失値、前記酸化剤ガスの前記電池スタック部分での圧力損失値、前記電池スタック部分の電圧より選択する少なくとも一つの物理量を入力し、前記燃料ガスの前記電池スタック部分への供給量制御部、前記燃料ガスの加湿制御部、前記酸化剤ガスの前記電池スタック部分への供給量制御部、前記酸化剤ガスの加湿制御部、電池冷却制御部より選択する少なくとも一つの制御部に制御信号を出力するガス加湿過多判定制御部を具備したことを特徴とする高分子電解質型燃料電池。

**【請求項2】** 前記燃料ガスの前記電池スタック部分での圧力損失値、前記酸化剤ガスの前記電池スタック部分での圧力損失値、前記電池スタック部分の電圧より選択する少なくとも一つの入力用物理量を測定し、前記物理量が時間的に先鋭的な変動を生じたとき、前記電池冷却制御部の冷却能を下げ前記単電池の温度を高める、前記燃料ガスの加湿量を下げる、前記酸化剤ガスの加湿量を下げる、前記燃料ガスの供給量を上げる、前記酸化剤ガスの供給量を上げるより選択する少なくとも一つの運転制御を行うことを特徴とする請求項1記載の高分子電解質型燃料電池の運転方法。

**【請求項3】** ガス加湿過多判定制御部は、連続的または一定時間間隔で入力用物理量を測定し、前記入力用物理量の時間的差分値または時間的微分値を求め、前記時間的差分値または時間的微分値が、予め定めた値より大きいとき、前記入力部物理量が先鋭的な変動を発生したと判断することを特徴とする請求項2記載の高分子電解質型燃料電池の運転方法。

**【請求項4】** 入力用物理量を予め定めた方法で平均化し、単発的ノイズを除去した後、時間的差分値または時間的微分値を求めることを特徴とする請求項3記載の高分子電解質型燃料電池の運転方法。

**【発明の詳細な説明】****【0001】**

**【発明の属する技術分野】**本発明は、ポータブル電源、電気自動車用電源、家庭内コージェネシステム等に使用する常温作動型の高分子電解質型燃料電池装置およびその運転方法に関する。

**【0002】**

**【従来の技術】**高分子電解質型燃料電池は、水素を含有する燃料ガスと、空気などの酸素を含有する酸化剤ガスとを、電気化学的に反応させることで、電力と熱とを同時に発生させるものである。その構造は、まず、水素イオンを選択的に輸送する高分子電解質膜の両面に、白金系の金属触媒を担持したカーボン粉末を主成分とする触媒反応層を形成する。次に、この触媒反応層の外面に、燃料ガスまたは酸化剤ガスの通気性と、電子導電性を併せ持つ拡散層を形成する。触媒反応層と拡散層とを合わせて電極とする。この電極と電解質膜とを接合したものをMEAと呼ぶ。

**【0003】**次に、供給する燃料ガスと酸化剤ガスとが外にリークしたり、互いに混合しないように、電極の周囲に高分子電解質膜を挟んでガasketを配置する。このガasketは、場合によっては、電極及び高分子電解質膜と一体化してあらかじめ組み立て、これをMEAと呼ぶ場合もある。

**【0004】**MEAの外側には、これを機械的に固定するとともに、隣接したMEAを互いに電氣的に直列に接続するための導電性のセパレータ板を配置する。セパレータ板のMEAと接触する部分には、電極面に燃料ガスや酸化剤ガスを供給し、生成水や余剰ガスを運び去るためのガス流路を形成する。ガス流路はセパレータ板と別に設けることもできるが、セパレータの表面に溝を設けてガス流路とする方式が一般的である。

**【0005】**通常、燃料電池を実際に使用するときは、必要とする電圧分だけ、上述の単電池を重ねた積層構造とする。燃料電池の運転時には電力発生と共に発熱が起る。積層電池では、単電池1～2セル毎に冷却板を設け、電池温度を一定に保つと同時に、発生した熱エネルギーを温水などの形で利用できるようにする。冷却板は薄い金属板の内部に冷却水などの熱媒体が貫流する構造が一般的であるが、単電池を構成するセパレータの背面、すなわち冷却水を流したい面を流路加工し冷却板を構成することも可能である。その際、冷却水などの熱媒体をシールするためのOリングやガasketが必要となる。この方式のシールにおいては、Oリングを完全につぶすなどして冷却板の上下間で十分な導電性が確保されていることが必要である。

【0006】このような積層電池では、各単電池へ燃料ガスや酸化剤ガスを供給、排出するためのマニホールと呼ばれる注入、排出口が必要である。これには、マニホールを積層電池の内部に確保した内部マニホール型と、積層電池の外部に確保した外部マニホール型に分かれる。

【0007】内部マニホール形式、または外部マニホール形式のいずれを用いても、冷却部を含む複数の単電池を一方向に積み重ね、その両端に一对の端板を配し、その2枚の端板の間を締結ロッドで固定することが必要である。締め付け方式は、単電池を面内でできるだけ均一に締め付けることが望ましい。機械的強度の観点から、端板や締結ロッドには通常ステンレスなどの金属材料を用いる。これらの端板や締結ロッドと、積層電池とは、絶縁板により電氣的に絶縁し、電流が端板を通して外部に漏れ出ることのない構造とする。締結ロッドについても、セパレータ内部の貫通孔の中を通したり、積層電池全体を端板越しに金属のベルトで締め上げる方式も提案されている。

【0008】以上に示した高分子電解質型燃料電池は、電解質膜が水分を含んだ状態で水素イオン伝導性を持つため、供給する燃料ガスや酸化剤ガスを加湿して供給する必要がある。また、高分子電解質膜は、少なくとも100℃までの温度範囲では、含水率が高くなればなるほど、イオン伝導度が増加し、電池の内部抵抗を低減させ、高性能にする効果がある。そこで、電解質膜中の含水率を高めるためには、供給ガスを高加湿にして供給する必要がある。しかしながら、電池運転温度以上の高加湿ガスを供給すると、電池内部で結露水が発生し、水滴がスムーズなガスの供給を阻害するとともに、酸化剤ガスを供給する空気極側では、発電によって水が生成するため、生成水の除去効率が低下し、電池性能を低下させる問題が発生する。そのため、通常は電池運転温度より若干低めの露点に加湿してガスを供給する。

【0009】供給ガスの加湿方法としては、所定の温度に保った脱イオン水中に供給ガスをバブリングし加湿するバブラー加湿方式や、電解質膜などの水分が容易に移動可能な膜の一方の面に所定の温度に保った脱イオン水を流し、他方の面に供給ガスを流して加湿する膜加湿方式が一般的である。燃料ガスとして、メタノールやメタンなどの化石燃料を水蒸気改質したガスを用いる場合には、改質ガス中に水蒸気を含んでいるため、加湿が必要ない場合もある。

【0010】加湿した燃料ガスや酸化剤ガスは、高分子電解質型燃料電池に供給され、発電に供する。このとき、電池積層体中の任意の単電池の単一面内では、電流密度の分布が発生する。すなわち、燃料ガスはガス供給入り口部で所定量の加湿がなされ供給されるが、燃料ガス中の水素が発電によって消費されるため、ガス上流部ほど水素分圧が高く水蒸気分圧が低く、ガス下流部ほど

水素分圧が低く水蒸気分圧が高くなる現象が発生する。

【0011】また、酸化剤ガスもガス供給入り口部で所定の加湿がなされ供給されるが、酸化剤ガス中の酸素が発電によって消費され、発電によって生成した水が発生するため、ガス上流部ほど酸素分圧が高く水蒸気分圧が低く、ガス下流部ほど酸素分圧が低く水蒸気分圧が高くなる現象が発生する。さらに、電池を冷却するための冷却水温度は、入り口ほど低く、出口ほど高くなるため、電池の単一面内に温度分布が発生する。以上のような理由から、電池の単一面内では電流密度分布（性能分布）が発生する。

【0012】また、上述のような理由で発生した、電池の単一面内での燃料ガス中の水素や水蒸気分圧の不均一や、酸化剤ガス中の酸素や水蒸気分圧の不均一、さらに温度分布などが、極端に大きくなり最適な状態から逸脱すると、極端な乾きすぎ（オーバードライ）状態や、極端な濡れすぎ（オーバーフラッディング）状態を招来し、電流密度分布の発生程度では収まらず、場合によっては電池として機能しなくなる。

【0013】さらに、上述のような理由で発生した、電池の単一面内での燃料ガス中の水素や水蒸気分圧の不均一や、酸化剤ガス中の酸素や水蒸気分圧の不均一、さらに温度分布などによって、電池の単一面内でオーバードライとオーバーフラッディングが共存する現象も発生しうる。

【0014】電池を高積層にした場合、積層した多数の電池の一部の電池に上述のような問題が発生すると、一部の性能低下した電池のために、積層電池全体の運転に支障を来す。すなわち、積層した電池の一部の電池がオーバーフラッディングに陥った場合、オーバーフラッディングに陥った電池は、ガス供給のための圧力損失が増大する。ガス供給のマニホールは、積層電池内で共通であるため、オーバーフラッディングに陥った電池には、ガスが流れにくくなり、結果として益々オーバーフラッディングを招来する。逆に、積層電池の一部がオーバードライに陥った場合、オーバードライに陥った電池は、ガス供給のための圧力損失が減少する。従って、オーバードライに陥った電池には、ガスが流れやすくなり、結果として益々オーバードライを招来する。

【0015】上述のような問題は、燃料ガスを供給する燃料極側においても、酸化剤ガスを供給する空気極側においても、ガス入り口側に比べてガス出口側ほどガス中の水蒸気分圧が高くなることに起因する場合が多い。そこで、特表平9-511356号公報に示されているように、酸化剤ガスの流れ方向と冷却水の流れ方向を同方向とし、冷却水の温度分布により酸化剤ガスの下流部の温度を上流部に比べて高くすることで、空気極下流部のオーバーフラッディングを抑制し、電池の単一面内の電流密度分布を低減させる試みもなされてきた。

【0016】しかしながら、電池にガスを供給する場

合、ガス入り口部では必ず圧力損失が存在するため、電池内部では、供給ガスの圧力分布も存在し、必ず入り口側が高圧になる。空気極側では、水が生成するため、水蒸気分圧は出口側ほど高くなるが、圧力分布の影響で、電池運転条件によっては、相対湿度は必ずしも出口側が高くなるとは限らない。そのため、入り口側ほど相対湿度が高くなる運転条件で電池を発電させ、酸化剤ガスの流れ方向と冷却水の流れ方向を同方向とし、冷却水の温度分布により酸化剤ガスの下流部の温度を上流部に比べて高くすると、ガス入り口側でのオーバーフラッディングが加速され逆効果となる。

#### 【0017】

【発明が解決しようとする課題】 上述のように、高分子電解質に対して必要以上に水蒸気もしくは水を供給すると、燃料ガスあるいは酸化剤ガス流路内で結露水が発生し、この結露水がスムーズなガスの供給を阻害するため、電池性能の低下が起こる。また、酸化剤ガスを供給するカソードでは、発電によって水が生成するため、さらに水の除去効率が低下し、電池性能を低下させる問題が発生する。この状態で放置すると、カソードとアノード間で転極現象がおり、極端な状況ではMEAが破損されるおそれがある。

【0018】このような電池性能の低下を防止するため、電池の出力電圧を測定し、出力電圧が所定値を下回ったとき、結露水が発生し、ガス供給の阻害や生成水の除去効率が低下したものと判断し、このとき、加湿量を下げ、ガス流量を増加することで結露水を除去する、という方法が提案されている。

【0019】しかし、そもそも実際の運転では、以上のような原因で電池電圧が低下することを未然に防ぐ運転方法が求められており、電池電圧のある程度の低下を許さねばならない点が従来方法の課題であった。

#### 【0020】

【課題を解決するための手段】 以上の課題を解決するため本発明の高分子電解質型燃料電池は、水素イオン伝導性高分子電解質膜と、前記水素イオン伝導性高分子電解質膜を挟む位置に配置した一対の電極とを具備した単電池を、前記電極の一方に水素を含む燃料ガスを供給排出し他方に酸素を含む酸化剤ガスを供給排出するガス供給溝を形成した導電性セパレータを介して積層し、前記単電池の冷却治具を具備した電池スタック部分；前記燃料ガスと前記酸化剤ガスを前記電池スタック部分に供給するガス供給用マニホールドと、前記電池スタック部分に供給した前記燃料ガスと前記酸化剤ガスを排出するためのガス排出用マニホールドと、前記単電池の冷却治具に供給する冷却媒体の流量または温度の少なくとも一方を制御する電池冷却制御部；前記燃料ガスの前記電池スタック部分への供給量制御部および前記燃料ガスの前記電池スタック部分での圧力損失測定部、または前記酸化剤ガスの前記電池スタック部分への供給量制御部およ

び前記酸化剤ガスの前記電池スタック部分での圧力損失測定部の少なくとも一方を具備し、前記電池スタック部分に供給する前記燃料ガスの加湿制御部、または前記電池スタック部分に供給する前記酸化剤ガスの加湿制御部の少なくとも一方、前記燃料ガスの前記電池スタック部分での圧力損失値、前記酸化剤ガスの前記電池スタック部分での圧力損失値、前記電池スタック部分の電圧より選択する少なくとも一つの物理量を入力し、前記燃料ガスの前記電池スタック部分への供給量制御部、前記燃料ガスの加湿制御部、前記酸化剤ガスの前記電池スタック部分への供給量制御部、前記酸化剤ガスの加湿制御部、電池冷却制御部より選択する少なくとも一つの制御部に制御信号を出力するガス加湿過多判定制御部を具備したことを特徴とする。

【0021】また、これを用いて、前記燃料ガスの前記電池スタック部分での圧力損失値、前記酸化剤ガスの前記電池スタック部分での圧力損失値、前記電池スタック部分の電圧より選択する少なくとも一つの入力用物理量を測定し、前記物理量が時間的に先鋭的な変動を生じたとき、前記電池冷却制御部の冷却能を下げ前記単電池の温度を高める、前記燃料ガスの加湿量を下げる、前記酸化剤ガスの加湿量を下げる、前記燃料ガスの供給量を上げる、前記酸化剤ガスの供給量を上げるより選択する少なくとも一つの運転制御を行うことを特徴とする。

【0022】このとき、ガス加湿過多判定制御部は、連続的または一定時間間隔で入力用物理量を測定し、前記入力用物理量の時間的差分値または時間的微分値を求め、前記時間的差分値または時間的微分値が、予め定めた値より大きいとき、前記入力部物理量が先鋭的な変動が発生したと判断することを特徴とする。

【0023】また、入力用物理量を予め定めた方法で平均化し、単発的ノイズを除去した後、時間的差分値または時間的微分値を求めることを特徴とする。

#### 【0024】

【発明の実施の形態】 本発明のポイントは、高分子電解質型燃料電池の運転中、燃料ガスあるいは酸化剤ガス流路内で結露水が発生し、電池性能の低下が起こるとき、その前兆として前記燃料ガスの前記電池スタック部分での圧力損失、前記酸化剤ガスの前記電池スタック部分での圧力損失、前記電池スタック部分の出力電圧または前記単電池の出力電圧が、時間的な先鋭的な変動、すなわちスパイク的な脈動を起こすことを、発明者は見いだしたことにある。

【0025】そこで、電池の運転中に、上述の先鋭的な変動が発生したとき、電池の結露水を除去する制御、すなわち、単電池に具備した冷却治具の冷却能を下げ前記単電池の温度を高める、燃料ガスの加湿量を下げる、酸化剤ガスの加湿量を下げる、燃料ガスの供給量を上げる、または酸化剤ガスの供給量を上げる制御を一旦施した後、もとの運転条件に戻すと、電池性能の低下が起こら

なかった。

【0026】圧力損失や電池電圧の、時間的な先鋭的変動の検出方法は、圧力損失や電池電圧を連続的、または一定間隔おきに測定し、この値の時間変化に対する差分値あるいは時間微分値を求め、これと予め定めた設定値と比較することで行うことができる。

【0027】以下、本発明の実施の形態について、図1から図8を用いて説明する。

【0028】(実施の形態1) 図1は、本発明の第1の実施の形態における高分子電解質型燃料電池を示す構成図である。以下、その動作を述べる。図1で、電池スタック部分とマニホールドをまとめた高分子電解質型燃料電池1、天然ガスなどの原料を水蒸気改質し、水素を主成分とする燃料ガスを生成し、電池スタック部分への燃料ガス供給量の調整手段を備えた燃料ガス供給制御部2、燃料ガス加湿制御部3、燃料ガスの電池スタック部分での圧力損失の測定部4、燃料ガス加湿過多判定制御部5、酸化剤ガス供給制御部6、酸化剤ガス加湿制御部7、冷却水制御部8、燃料電池1で発生した熱を給湯に用いるための貯湯槽9、電池ユニット部の出力電圧測定装置10を備える。

【0029】本発明のポイントは燃料ガス加湿過多判定制御部5である。この制御部5は、燃料ガスの電池スタック部分での圧力損失の測定部4および高分子電解質型燃料電池1の出力電圧測定部10からの信号を受けて、燃料ガス供給制御部2、燃料ガス加湿制御部3あるいは冷却水制御部8に信号を送り、これらの量を制御するものである。

【0030】以下、実施例で具体的に記載する。

【0031】

【実施例】(実施例1) まず、燃料電池の製造方法を説明する。炭素微粉末(米国キャボット社製VXC72、一次粒子径: 30 nm、比表面積: 254 m<sup>2</sup>/g)に、平均粒径約30 Åの白金粒子を25重量%担持したものを電極の触媒とした。この触媒粉末をイソプロパノールに分散させた溶液に、水素イオン伝導性高分子電解質であるパーフルオロカーボンスルホン酸の粉末をエチルアルコールに分散したディスパージョン溶液を混合し、触媒ペーストを作成した。

【0032】一方、電極の多孔性基材となるカーボンペーパーを撥水処理した。厚み360 μmのカーボン不織布(東レ製、TGP-H-120)を、ポリテトラフルオロエチレン含有の水性ディスパージョン(ダイキン工業製、ネオフロンND1)に含浸した後、これを乾燥し、400℃で30分加熱することで、撥水性を与えた。

【0033】このカーボン不織布の上に、前述の触媒ペーストをクリーン印刷法をもちいて塗布することで触媒層を形成した。このようにして作成した触媒層とカーボン不織布とを合わせて電極とした。電極中に含まれる白

金量は0.5 mg/cm<sup>2</sup>、パーフルオロカーボンスルホン酸の量は1.2 mg/cm<sup>2</sup>となるよう調整した。

【0034】次に、外寸の大きさを前述の電極より5 mm大きくした、プロトン伝導性高分子電解質膜(米国デュポン社製、ナフイオン112)の裏表両面に、一対の電極を触媒層が電解質膜の側に接するようにホットプレスで接合し、これを電極電解質膜接合体(MEA)とした。

【0035】このMEAをセパレータ板で挟み込んで単電池の構成とした。セパレータ板の作成は、カーボン粉末材料を冷間プレス成形したカーボン板に、フェノール樹脂を含浸・硬化させガスシール性を改善した樹脂含浸したものを用い、これに切削加工でガス流路を形成した。セパレータの大きさは10 cm×20 cm、厚さは4 mmであり、溝部は幅2 mmで深さ1.5 mmの凹部であり、この部分をガスが流通する。また、ガス流路間のリブ部は幅1 mmの凸部である。また、酸化剤ガスのマニホールド孔と、燃料ガスのマニホールド孔と、冷却水のマニホールド孔を、セパレータに形成した。また、ガス流路と、マニホールド孔の周りに、ポリイソブチレンに導電性カーボンを分散させた導電性のガスシール剤で、ガスシール部を形成した。

【0036】以上のように作成したMEAの両面に、導電性セパレータの表面の燃料ガス流通側と、導電性セパレータの裏面の酸化剤ガス流通側とを接合し、単電池Aとした。また、MEAの両面に、導電性セパレータの表面の燃料ガス流通側と、導電性セパレータの裏面の冷却水流通側とを接合し、単電池Bとした。

【0037】次に、単電池Aと単電池Bとを1セルずつ交互に積層し、合計で50セル積層することで、単位電池の積層部分とした。

【0038】この積層体の上下にエンドプレートを配し締結した。このとき、組立時の締結圧力を13 kgf/cm<sup>2</sup>とした。このようにして作成した電池スタック部分にガス供給排出用マニホールドを取り付け、図1に示した構成のシステムを作成した。

【0039】このシステムを下記の条件で運転し、燃料ガスの電池スタック部分での圧力損失と電池ユニット部の出力電圧を測定し、その結果を図2と図3に示した。図2および図3において、左縦軸は単電池当たりの電池の出力電圧、右縦軸は燃料ガスの圧力損失、横軸は運転時間を示したものであり、サンプリングは0.1秒ごとに行った。

【0040】運転条件は、冷却水の温度と流量を制御することで燃料電池の温度を85℃に保持し、燃料利用率80%、酸素利用率40%、電流密度0.2 A/cm<sup>2</sup>は共通の条件とし、燃料ガスに露点80℃の水蒸気を加湿したとき(以下条件1とする)の結果を図2に示し、燃料ガスに露点70℃の水蒸気を加湿したときの結果(以下条件2とする)を図3に示した。

【0041】条件1においては、燃料ガスの加湿が過多になっており、燃料ガス流路の閉塞が頻繁に発生していることを、事前実験において黙視で確認した。この燃料ガス流路の閉塞により、燃料ガスの圧力損失は一時的に上昇する。そして、燃料ガス流路を閉塞した結露水を除去できる圧力まで、燃料ガス圧力が上昇した後に、燃料ガス圧力損失は低下する。この際、図2に示したような燃料ガス圧力の先鋭的な変動が見られた。また同時に電池の出力電圧にも同様の先鋭的な変動が見られた。図2は、20秒間の測定結果を示したが、この先鋭的な変動はおおよそ20秒間隔で発生した。

【0042】これに対して、条件2では、燃料ガスの加湿は適正であり、燃料ガス圧力損失や出力電圧は、ほぼ一定の値を示している。このときも、事前実験において燃料ガス流路の閉塞は発生していないことを確認した。

【0043】図4および図5は、それぞれ、条件1と条件2における燃料ガスの圧力損失の時間差分値、単セル当たりの電池出力電圧の時間差分値を示したものである。条件1では図4に示したように、燃料ガスの圧力損失の時間差分値、単セル当たりの電池出力電圧の時間差分値ともに、ある一点（運転時間7秒時点）においてピークを示した。そこで、燃料ガスの圧力損失、単セル電圧出力の時間差分値を計算し、これをあらかじめ定めておいた設定値と比較することで、上述と同じく燃料ガスの加湿過多を検出することができた。条件2では図5に示したように、燃料ガスの圧力損失、単セル電圧出力の時間差分値ともに、図4のピークは検出されなかった。

【0044】以上のような方法で、燃料ガス加湿過多判定器5が燃料ガスの加湿過多を検出した時、燃料ガス加湿器3に信号を送り加湿量を下げる、または、燃料ガス供給装置2に信号を送り燃料ガス供給量を増やす、または冷却水制御ユニット8に信号を送り冷却水流量を減らすことで、一旦、結露水除去動作を行う。この結露水除去動作は、上記の加湿過多検出方法で加湿過多が検出されなくなってから一定の時間続ける、あるいは後述の加湿不足検出方法によって加湿の不足を検出するまで継続したのち、必要とする運転条件に戻す。

【0045】以上の動作を通常運転に取り込むことで、燃料ガス流路の閉塞を除去し、高分子電解質型燃料電池1の安定運転を継続することができた。

【0046】以上では、燃料ガスを加湿する場合について説明したが、酸化剤ガスを加湿する場合においても酸化剤ガス側に同様の手段を設けることで、酸化剤ガスの加湿過多を検出することができる。

【0047】なお、ここで用いられている貯湯槽9は本発明の実施の必須の要件ではない。また、燃料ガス加湿器3は、図1に示したように燃料ガス供給装置2と別体の構成としたが、一体の構成であっても、加湿量が制御できる方式であれば、本発明の実施は可能である。

【0048】また、入力用物理量を予め定めた方法で平

均化し、単発的ノイズを除去した後、時間的差分値または時間的微分値を求めることができることはいうまでもない。

【0049】（実施例2）次に、本発明の第2の実施例を図面を参照して説明する。

【0050】図6は、本発明の第2の実施例である燃料電池システムの構成を示す概念図である。本実施例の燃料電池システムは、燃料ガス加湿不足検出部11が加わっていること以外は、上述の実施例1のシステムと同じである。

【0051】図7および図8は、燃料ガスの電池スタック部分での圧力損失の時間経過を示したものである。図7は燃料ガスに露点70℃の水蒸気を加湿したとき（以下条件3とする）の結果を、図8は燃料ガスに露点65℃の水蒸気を加湿したときの結果（以下条件4とする）を示した。これ以外の条件は実施例1と同一とした。

【0052】図7と図8において、条件3と条件4を比較すると、加湿量が少ないほど、燃料ガスの圧力損失が小さくなることを見いだした。したがって、燃料ガス圧力損失を、予め定めた設定値と比較してそれを下回る時、燃料ガスの加湿が不足していると判断することができる。燃料ガスの圧力損失は、加湿量の他、燃料ガス流量によって変化するから、前記設定値は燃料ガス流量と加湿量の関数として求めるか、あるいは燃料ガス流量と加湿量を変化させて事前に測定する必要がある。

【0053】以上、本発明の第2の実施例を説明した。ここでは燃料ガスを加湿する場合の高分子電解質型燃料電池装置について説明したが、酸化剤ガスを加湿する場合においても酸化剤ガス側に同様の手段を設けることで、酸化剤ガスの加湿不足を検出することができる。

【0054】

【発明の効果】以上のように、本発明の高分子電解質型燃料電池およびその運転方法は、燃料ガスおよび酸化剤ガスの加湿量を加湿過多にすることなく制御することで、高分子電解質型燃料装置の安定した連続運転を可能にするものである。

【図面の簡単な説明】

【図1】本発明の第1の実施例の高分子電解質型燃料電池のシステム構成を示す概念図

【図2】本発明の第1の実施例の高分子電解質型燃料電池の第1の運転条件での出力電圧と圧力損失の時間変化を示した図

【図3】本発明の第1の実施例の高分子電解質型燃料電池の第2の運転条件での出力電圧と圧力損失の時間変化を示した図

【図4】本発明の第1の実施例の高分子電解質型燃料電池の第1の運転条件での出力電圧と圧力損失の時間変化率を示した図

【図5】本発明の第1の実施例の高分子電解質型燃料電池の第2の運転条件での出力電圧と圧力損失の時間変化



率を示した図

【図6】本発明の第2の実施例の高分子電解質型燃料電池のシステム構成を示す概念図

【図7】本発明の第2の実施例の高分子電解質型燃料電池の第3の運転条件での圧力損失の時間変化を示した図

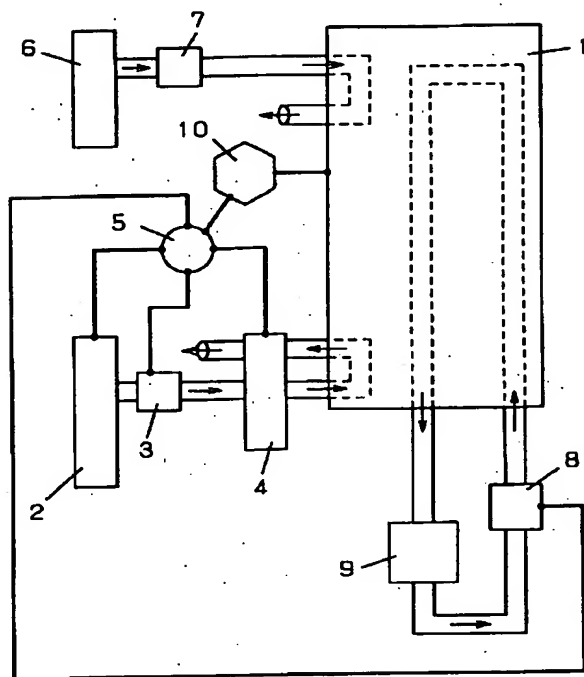
【図8】本発明の第2の実施例の高分子電解質型燃料電池の第4の運転条件での圧力損失の時間変化を示した図

【符号の説明】

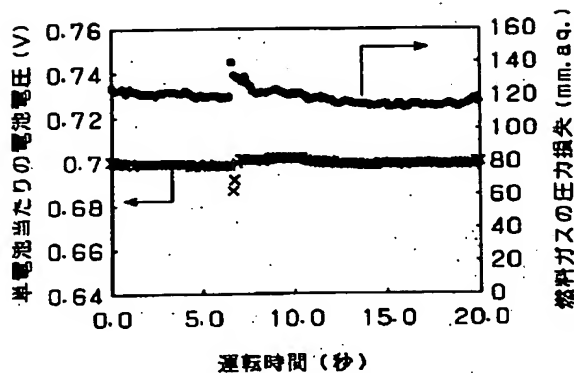
- 1 高分子電解質型燃料電池
- 2 燃料ガス供給制御部

- 3 燃料ガス加湿制御部
- 4 燃料ガス圧力損失の測定部
- 5 燃料ガス加湿過多判定制御部
- 6 酸化剤ガス供給制御部
- 7 酸化剤ガス加湿制御部
- 8 冷却水制御部
- 9 貯湯槽
- 10 出力電圧測定装置
- 11 燃料ガス加湿不足検出装置

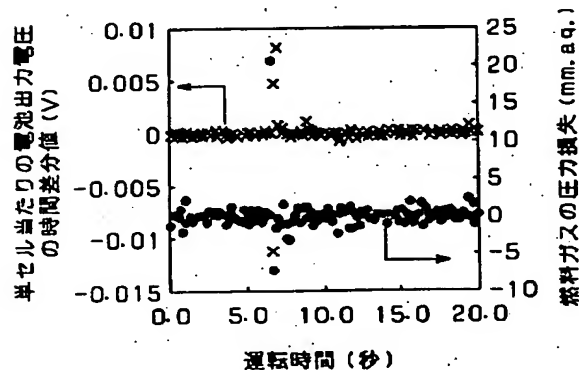
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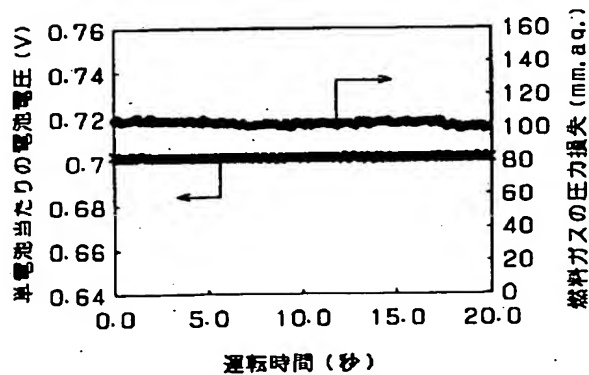
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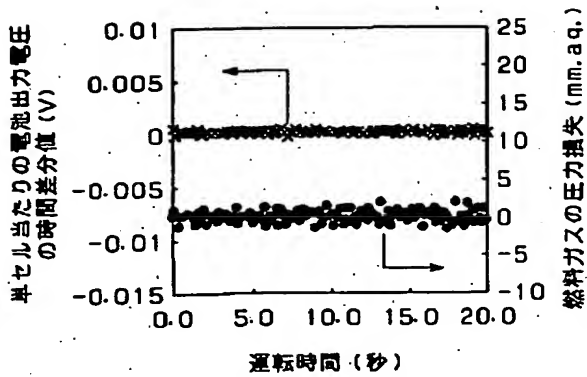


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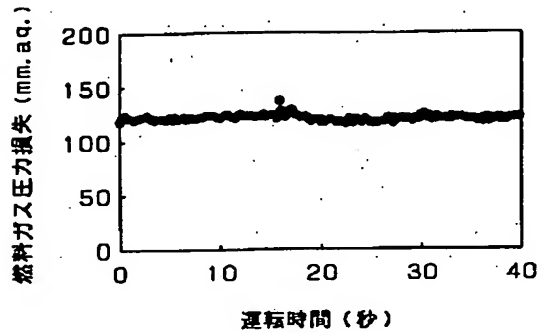




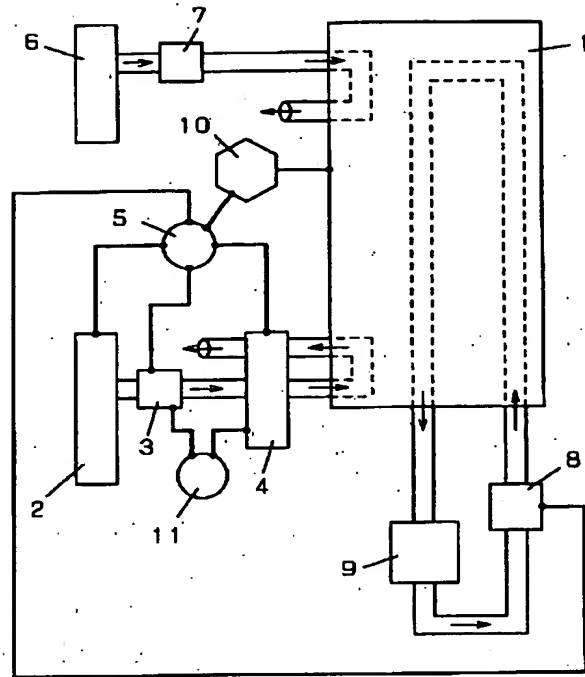
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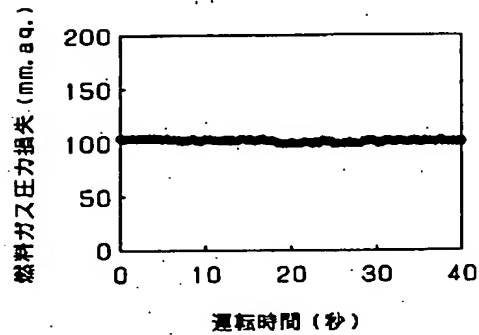
【図7】



【図6】



【図8】



フロントページの続き

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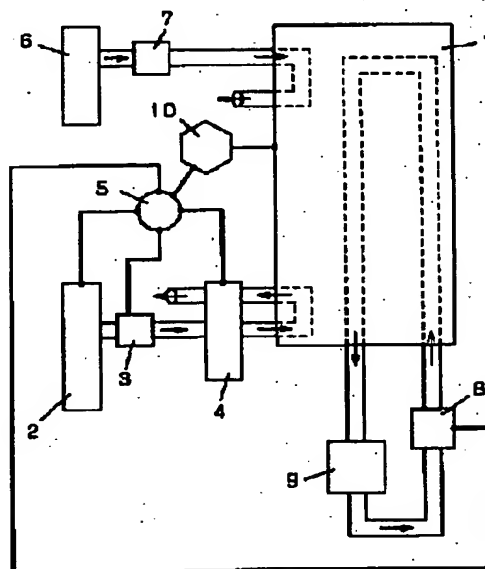
**(54) HIGH POLYMER ELECTROLYTE TYPE FUEL  
CELL AND ITS OPERATION METHOD**

**(57) Abstract:**

**PROBLEM TO BE SOLVED:** To prevent deterioration in a characteristic by a dew condensation water generated inside a battery in a high polymer electrolyte type fuel cell.

**SOLUTION:** A pressure loss of a fuel or an oxidation gas in a flow inside of a fuel cell, an absolute value of a time difference value of a voltage generated in a single cell or a differentiation value are calculated and by performing value comparison with a presetting value defined beforehand. When the fuel or the oxidation gas has too much humidify, a temperature of a cell is raised, or an amount of humidifying of a gas is lowered.

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CLAIMS

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## [Claim(s)]

[Claim 1] A polyelectrolyte mold fuel cell characterized by providing the following A hydrogen ion conductivity polyelectrolyte film The cell stack portion which carried out the supply discharge of the fuel gas which contains hydrogen in one side of said electrode for a cell possessing an electrode of a pair arranged in a location which sandwiches said hydrogen ion conductivity polyelectrolyte film, carried out a laminating through the conductive separator formed the gas-supply slot which carries out supply discharge of the oxidizer gas containing oxygen on another side, and possesses the cooling fixture of said cell, the manifold for gas supply which supply said fuel gas and said oxidizer gas to said cell stack portion A manifold for gas discharge for discharging said fuel gas supplied to said cell stack portion, and said oxidizer gas A cell cooling control section which controls either [ at least ] a flow rate of a cooling medium supplied to a cooling fixture of said cell, or temperature, An amount-of-supply control section to said cell stack portion of said fuel gas, and a pressure loss test section in said cell stack portion of said fuel gas, An amount-of-supply control section to said cell stack portion of said oxidizer gas and a pressure loss test section in said cell stack portion of said oxidizer gas at least or on the other hand Either [ at least ] a humidification control section of said fuel gas supplied to said cell stack portion or a humidification control section of said oxidizer gas supplied to said cell stack portion is provided. A pressure loss value in said cell stack portion of said fuel gas, a pressure loss value in said cell stack portion of said oxidizer gas, At least one physical quantity chosen from voltage of said cell stack portion is inputted. An amount-of-supply control section to said cell stack portion of said fuel gas, a humidification control section of said fuel gas, An amount-of-supply control section to said cell stack portion of said oxidizer gas, a humidification control section of said oxidizer gas, a gas humidification excessive judging control section that outputs a control signal to at least one control section chosen from a cell cooling control section

[Claim 2] A pressure loss value in said cell stack portion of said fuel gas, a pressure loss value in said cell stack portion of said oxidizer gas, When at least one physical quantity for an input chosen from voltage of said cell stack portion is measured and said physical quantity produces acute fluctuation in time, Lower the amount of humidification of said fuel gas which raises temperature of the lowering aforementioned cell for cooling power of said cell cooling control section. An operating method of a polyelectrolyte mold fuel cell according to claim 1 characterized by performing at least one operation control which raises the amount of supply of said fuel gas which lowers the amount of humidification of said oxidizer gas, and which is chosen rather than it raises the amount of supply of said oxidizer gas.

[Claim 3] a gas humidification excessive judging control section measures physical quantity for an input with continuous or a fixed time interval, and said physical quantity for an input is time -- difference -- a value or a time differential value -- asking -- said -- time -- difference -- an operating method of a polyelectrolyte mold fuel cell according to claim 2 characterized by judging that acute fluctuation of said input section physical quantity was generated when a value or a time differential value is larger than a value defined beforehand.

[Claim 4] time, after equalizing by method which defined physical quantity for an input beforehand and

removing a single-engined noise -- difference -- an operating method of a polyelectrolyte mold fuel cell according to claim 3 characterized by calculating a value or a time differential value.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention -- the power supply for a portable power supply and electric vehicles, and domestic -- cogeneration -- it is related with the polyelectrolyte mold fuel cell equipment of the ordinary temperature actuation mold used for a system etc., and its operating method.

[0002]

[Description of the Prior Art] A polyelectrolyte mold fuel cell is making the fuel gas containing hydrogen, and the oxidizer gas containing oxygen, such as air, react electrochemically, and makes coincidence generate power and heat. The structure forms first the catalytic-reaction layer which uses as a principal component the carbon powder which supported the metal catalyst of a platinum system in both sides of a polyelectrolyte film to which a hydrogen ion is conveyed alternatively. Next, the diffusion layer having the permeability of fuel gas or oxidizer gas and electronic conductivity is formed in the external surface of this catalytic-reaction layer. A catalytic-reaction layer and a diffusion layer are doubled and it considers as an electrode. What joined this electrode and an electrolyte film is called MEA.

[0003] Next, the fuel gas and oxidizer gas to supply leak outside, or on both sides of a polyelectrolyte film, a gasket is arranged around an electrode so that it may not mix mutually. It may unite with an electrode and a polyelectrolyte film depending on the case, and this gasket may be assembled beforehand, and may call this MEA.

[0004] In the outside of MEA, while fixing this mechanically, the conductive separator board for connecting adjoining MEA to a serial electrically mutually is arranged. Fuel gas and oxidizer gas are supplied to an electrode side, and the gas passageway for carrying away generation water and surplus gas is formed in the portion in contact with MEA of a separator board. Although a gas passageway can also be prepared apart from a separator board, the method which prepares a slot on the surface of a separator, and is made into a gas passageway is common.

above-mentioned cell by the voltage to need. At the time of operation of a fuel cell, pyrexia takes place with power generating. It enables it to use the generated heat energy in the form of warm water etc. with a layer built cell at the same time it forms a cooling plate every one to cell 2 cel and keeps cell temperature constant. Although the structure of a cooling plate where heat carriers, such as cooling water, flow through is common to the interior of a thin metal plate, it is also possible to carry out passage processing of the back of the separator which constitutes a cell, i.e., the field which wants to pour cooling water, and to constitute a cooling plate. The O ring and the gasket for carrying out the seal of the heat carriers, such as cooling water, are needed in that case. In the seal of this method, O ring is crushed completely, it is between the upper and lower sides of a cooling plate, and it is required to secure sufficient conductivity.

[0006] The impregnation and the exhaust port which are called the manifold for supplied and

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[0004] In the outside of MEA, while fixing this mechanically, the conductive separator board for connecting adjoining MEA to a serial electrically mutually is arranged. Fuel gas and oxidizer gas are supplied to an electrode side, and the gas passageway for carrying away generation water and surplus gas is formed in the portion in contact with MEA of a separator board. Although a gas passageway can also be prepared apart from a separator board, the method which prepares a slot on the surface of a separator, and is made into a gas passageway is common.

[0005] Usually, when actually using a fuel cell, it considers as the laminated structure which piled up the above-mentioned cell by the voltage to need. At the time of operation of a fuel cell, pyrexia takes place with power generating. It enables it to use the generated heat energy in the form of warm water etc. with a layer built cell at the same time it forms a cooling plate every one to cell 2 cel and keeps cell temperature constant. Although the structure of a cooling plate where heat carriers, such as cooling water, flow through is common to the interior of a thin metal plate, it is also possible to carry out passage processing of the back of the separator which constitutes a cell, i.e., the field which wants to pour cooling water, and to constitute a cooling plate. The O ring and the gasket for carrying out the seal of the heat carriers, such as cooling water, are needed in that case. In the seal of this method, O ring is crushed completely, it is between the upper and lower sides of a cooling plate, and it is required to secure sufficient conductivity.

[0006] The impregnation and the exhaust port which are called the manifold for supplied and

discharging fuel gas and oxidizer gas to each cell are required of such a layer built cell. It is divided into the internal manifold mold which secured this the manifold inside the layer built cell, and the external manifold mold secured in the exterior of a layer built cell.

[0007] Even if it uses any of internal manifold format or external manifold format, it is required to accumulate two or more cells containing the cooling section on an one direction, to arrange the end plate of a pair on the both ends, and to fix between the end plate of two sheets with a conclusion rod. As for a bolting method, it is desirable to bind a cell tight to homogeneity as much as possible in a field. From a viewpoint of a mechanical strength, metallic materials, such as stainless steel, are usually used for an end plate or a conclusion rod. It insulates electrically with an electric insulating plate, and these end plates and conclusion rods, and a layer built cell are made into the structure out of which current does not leak and come outside through an end plate. Also about the conclusion rod, it lets the inside of the through tube inside a separator pass, or the method which screws up the whole laminating pond by the metaled belt over an end plate is also proposed.

[0008] Since an electrolyte film has hydrogen ion conductivity where moisture is included, the polyelectrolyte mold fuel cell shown above needs to humidify and supply fuel gas and oxidizer gas to supply. Moreover, the more water content becomes high, ionic conductivity increases, the internal resistance of a cell is reduced, and, the more a polyelectrolyte film has the effect made into high performance in the temperature requirement to at least 100 degrees C. So, in order to raise the water content in an electrolyte film, it is necessary to supply by making distributed gas high humidification. However, in the air pole side which supplies oxidizer gas, if the high humidification gas more than a cell operating temperature is supplied, while dew condensation water will be generated inside a cell and waterdrop will check supply of smooth gas, in order that water may generate by generation of electrical energy, the problem on which the removal effectiveness of generation water falls to and the cell engine performance is reduced occurs. Therefore, it humidifies at a dew-point [ a little ] usually lower than a cell operating temperature, and gas is supplied.

[0009] The bubbler humidification method which carries out bubbling of the distributed gas and humidifies it in the deionized water maintained at a predetermined temperature as the humidification method of distributed gas, and the film humidification method which the moisture of an electrolyte film etc. passes distributed gas for the deionized water kept easy to a predetermined temperature in one field of a movable film to the field of a sink and another side, and is humidified are common. Since it contains the steam in reformed gas in using the gas which carried out steam reforming of the fossil fuels, such as a methanol and methane, as fuel gas, humidification may be unnecessary.

[0010] Fuel gas and oxidizer gas which were humidified are supplied to a polyelectrolyte mold fuel cell, and a generation of electrical energy is presented with them. At this time, distribution of current density occurs in the single side of the cell of the arbitration in a cell layered product. That is, although humidification of the specified quantity is made and fuel gas is supplied in the gas supply entry section, since the hydrogen in fuel gas is consumed by generation of electrical energy, the phenomenon in which a hydrogen partial pressure is high, a steam partial pressure becomes as the gas upstream section, and a steam partial pressure becomes [ a hydrogen partial pressure ] low highly generates a gas downstream.

[0011] Moreover, although humidification predetermined in the gas supply entry section is made and oxidizer gas is also supplied, the oxygen in oxidizer gas is consumed by generation of electrical energy, and since the water generated by generation of electrical energy is generated, the phenomenon in which oxygen tension is high, a steam partial pressure becomes as the gas upstream section, and a steam partial pressure becomes [ oxygen tension ] low highly generates a gas downstream. Furthermore, the circulating water temperature for cooling a cell is as low as an entry, and since an outlet becomes high, temperature distribution occur in the single side of a cell. Since it is above, in the single side of a cell, current density distribution (engine-performance distribution) occurs.

[0012] Moreover, if temperature distribution etc. become extremely large at the hydrogen in the fuel gas in the single side of a cell and the ununiformity of a steam partial pressure which were generated in the above reasons, the oxygen in oxidizer gas, the ununiformity of a steam partial pressure, and a pan and it deviates from the optimal condition extreme -- getting dry -- passing (exaggerated dry cleaning) -- a



condition -- extreme -- it gets wet too much (exaggerated flooding), and a condition is invited, and it is not settled but stops functioning as a cell in the generating degree of current density distribution depending on the case

[0013] Furthermore, the hydrogen in the fuel gas in the single side of a cell and the ununiformity of a steam partial pressure which were generated in the above reasons, the oxygen in oxidizer gas, the ununiformity of a steam partial pressure, and the phenomenon in which exaggerated dry cleaning and exaggerated flooding live together in the single side of a cell may also be further generated according to temperature distribution etc.

[0014] If the above problems occur on some cells of the cell of a large number which carried out the laminating when a cell is made into a high laminating, trouble will be caused to operation of the whole layer built cell for the cell in which the part carried out degradation. Namely, when some cells of the cell which carried out the laminating lapse into exaggerated flooding, as for the cell which lapsed into exaggerated flooding, the pressure loss for gas supply increases. Since the manifold of gas supply is common within a layer built cell, gas stops being able to flow on the cell which lapsed into exaggerated flooding easily, and it invites exaggerated flooding to it increasingly as a result. On the contrary, when some layer built cells lapse into exaggerated dry cleaning, as for the cell which lapsed into exaggerated dry cleaning, the pressure loss for gas supply decreases. Therefore, gas becomes easy to flow on the cell which lapsed into exaggerated dry cleaning, and exaggerated dry cleaning is increasingly invited to it as a result.

[0015] Compared with a gas entry side, a gas outlet side originates in the steam partial pressure in gas becoming high at the air pole side which supplies oxidizer gas to the fuel electrode side with which the above problems supply fuel gas in many cases. Then, by making the flow direction of oxidizer gas, and the flow direction of cooling water into this direction, and making temperature of the downstream of oxidizer gas high compared with the upper section according to the temperature distribution of cooling water, the exaggerated flooding of an air pole downstream was controlled and the attempt which reduces the current density distribution within the single side of a cell has also been made as shown in the \*\*\*\*\* No. 511356 [ nine to ] official report.

[0016] However, in the gas entry section, when supplying gas to a cell, since pressure loss surely exists, inside a cell, the pressure distribution of distributed gas also exist and an entry side surely becomes high pressure. In an air pole side, in order that water may generate, although an outlet side becomes high [ the partial pressure of a steam ], it is the effect of pressure distribution and, as for relative humidity, an outlet side does not necessarily become high depending on a cell service condition. Therefore, if an entry side makes a cell generate by the service condition to which relative humidity becomes high, makes this direction the flow direction of oxidizer gas, and the flow direction of cooling water and makes temperature of the downstream of oxidizer gas high compared with the upper section according to the temperature distribution of cooling water, the exaggerated flooding by the side of a gas entry will be accelerated, and it will become an opposite effect.

[0017]

[Problem(s) to be Solved by the Invention] As mentioned above, if a steam or water is supplied to a polyelectrolyte beyond necessity, in order that dew condensation water may be generated within fuel gas or an oxidizer gas passageway and this dew condensation water may check supply of smooth gas, cell performance degradation happens. Moreover, in the cathode which supplies oxidizer gas, in order that water may generate by generation of electrical energy, the problem on which the removal effectiveness of water falls to further and the cell engine performance is reduced occurs. When it is left in this condition, a polarity inversion phenomenon starts between a cathode and an anode, and there is a possibility that MEA may be damaged, in an extreme condition.

[0018] In order to prevent such cell performance degradation, when the output voltage of a cell is measured and output voltage is less than a predetermined value, dew condensation water is generated, it is judged as that to which the removal effectiveness of inhibition of gas supply or generation water fell, and the method of removing dew condensation water by increasing lowering and a quantity of gas flow for the amount of humidification is proposed at this time.

[0019] However, by actual operation, the operating method to prevent was primarily called [ that cell voltage falls and ] for by the above causes, and the point that a certain amount of fall of cell voltage had to be allowed was the technical problem of the conventional method.

[0020]

[Means for Solving the Problem] In order to solve the above technical problem a polyelectrolyte mold fuel cell of this invention A cell possessing a hydrogen ion conductivity polyelectrolyte film and an electrode of a pair arranged in a location which sandwiches said hydrogen ion conductivity polyelectrolyte film Carry out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and a laminating is carried out through a conductive separator in which a gas supply slot which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side. A cell stack portion possessing a cooling fixture of said cell; A manifold for gas supply which supplies said fuel gas and said oxidizer gas to said cell stack portion, A manifold for gas discharge for discharging said fuel gas supplied to said cell stack portion, and said oxidizer gas, A cell cooling control section which controls either [ at least ] a flow rate of a cooling medium supplied to a cooling fixture of said cell, or temperature; An amount-of-supply control section to said cell stack portion of said fuel gas, and a pressure loss test section in said cell stack portion of said fuel gas, Or either [ at least ] an amount-of-supply control section to said cell stack portion of said oxidizer gas or a pressure loss test section in said cell stack portion of said oxidizer gas is provided. A humidification control section of said fuel gas supplied to said cell stack portion or a humidification control section of said oxidizer gas supplied to said cell stack portion at least on the other hand A pressure loss value in said cell stack portion of said fuel gas, a pressure loss value in said cell stack portion of said oxidizer gas, At least one physical quantity chosen from voltage of said cell stack portion is inputted. An amount-of-supply control section to said cell stack portion of said fuel gas, a humidification control section of said fuel gas, It is characterized by providing a gas humidification excessive judging control section which outputs a control signal to at least one control section chosen from an amount-of-supply control section to said cell stack portion of said oxidizer gas, a humidification control section of said oxidizer gas, and a cell cooling control section.

[0021] This is used. Moreover, a pressure loss value in said cell stack portion of said fuel gas, When at least one physical quantity for an input chosen from a pressure loss value in said cell stack portion of said oxidizer gas and voltage of said cell stack portion is measured and said physical quantity produces acute fluctuation in time, It is characterized by performing at least one operation control which raises the amount of supply of said fuel gas which lowers the amount of humidification of said oxidizer gas which lowers the amount of humidification of said fuel gas which raises temperature of the lowering aforementioned cell for cooling power of said cell cooling control section and which is chosen rather than it raises the amount of supply of said oxidizer gas.

[0022] at this time, a gas humidification excessive judging control section measures physical quantity for an input with continuous or a fixed time interval, and said physical quantity for an input is time -- difference -- a value or a time differential value -- asking -- said -- time -- difference -- when a value or a time differential value is larger than a value defined beforehand, it is characterized by judging that acute fluctuation of said input section physical quantity was generated.

[0023] moreover, time, after equalizing by method which defined physical quantity for an input beforehand and removing a single-engined noise -- difference -- it is characterized by calculating a value or a time differential value.

[0024]

[Embodiment of the Invention] When dew condensation water generates the point of this invention within fuel gas or an oxidizer gas passageway during operation of a polyelectrolyte mold fuel cell and cell performance degradation happens, an artificer has [ causing acute time fluctuation, i.e., spike-pulsation, and ] the output voltage of the pressure loss in said cell stack portion of said fuel gas, the pressure loss in said cell stack portion of said oxidizer gas, and said cell stack portion, or the output voltage of said cell in having found out as the sign.

[0025] Then, the control which removes the dew condensation water of a cell when above-mentioned

acute fluctuation occurs during operation of a cell, Namely, raise the temperature of the lowering aforementioned cell for the cooling power of the cooling fixture provided in a cell. Once raising the amount of supply of fuel gas which lowers the amount of humidification of fuel gas and which lowers the amount of humidification of oxidizer gas or performing control which raises the amount of supply of oxidizer gas, when it returned to the service condition of a basis, cell performance degradation did not happen.

[0026] difference [ as opposed to / the time detection method of acute fluctuation of pressure loss or cell voltage measures pressure loss and cell voltage every / continuously or / fixed gap, and / time amount change of this value ] -- a value or a time amount differential value can be calculated, and it can carry out by comparing with the set point beforehand determined as this.

[0027] Hereafter, the gestalt of operation of this invention is explained using drawing 8 from drawing 1.

[0028] (Gestalt 1 of operation) Drawing 1 is the block diagram showing the polyelectrolyte mold fuel cell in the gestalt of operation of the 1st of this invention. Hereafter, the actuation is described. By drawing 1, steam reforming of the raw materials into which the cell stack portion and the manifold were packed, such as the polyelectrolyte mold fuel cell 1 and natural gas, is carried out. The fuel gas which uses hydrogen as a principal component is generated. The adjustment means of the fuel gas amount of supply to a cell stack portion The heat generated with the fuel gas supply control section 2 which it had, the fuel gas humidification control section 3, the test section 4 of the pressure loss in the cell stack portion of fuel gas, the fuel gas humidification excessive judging control section 5, the oxidizer gas supply control section 6, the oxidizer gas humidification control section 7, the cooling water control section 8, and the fuel cell 1 It has \*\*\*\*\* 9 for using for hot-water supply, and the output voltage measuring device 10 of the cell unit section.

[0029] The point of this invention is the fuel gas humidification excessive judging control section 5. This control section 5 controls delivery and these amounts for a signal in response to the signal from the test section 4 of the pressure loss in the cell stack portion of fuel gas, and the output voltage test section 10 of the polyelectrolyte mold fuel cell 1 to the fuel gas supply control section 2, the fuel gas humidification control section 3, or the cooling water control section 8.

[0030] Hereafter, an example indicates concretely.

[0031]

[Example] (Example 1) The manufacture method of a fuel cell is explained first. What supported the platinum particle with a mean particle diameter of about 30A 25% of the weight to carbon impalpable powder (VXC72 by U.S. Cabot Corp., the diameter of a primary particle: 30nm, specific-surface-area:254m<sup>2</sup>/g) was made into the catalyst of an electrode. In the solution which made isopropanol distribute this catalyst powder, the dispersion solution which distributed the powder of the perfluorocarbon sulfonic acid which is a hydrogen ion conductivity polyelectrolyte in ethyl alcohol was mixed, and the catalyst paste was created in it.

[0032] On the other hand, the carbon paper used as the porous base material of an electrode was given a water-repellent finish. After sinking into the aquosity dispersion (the Daikin Industries make, neo chlorofluorocarbon ND 1) of polytetrafluoroethylene content of a carbon nonwoven fabric (the Toray Industries make, TGP-H -120) with a thickness of 360 micrometers, this was dried and water repellence was given by heating at 400 degrees C for 30 minutes.

[0033] The catalyst bed was formed by having the above-mentioned catalyst paste, it being and applying clean print processes on this carbon nonwoven fabric. Thus, the catalyst bed and carbon nonwoven fabric which were created were set, and it considered as the electrode. The amount of platinum contained in an electrode was adjusted so that 0.5mg/cm of 1.2mg /of amounts of 2 and perfluorocarbon sulfonic acid might be set to 2 cm.

[0034] Next, to both-sides both sides of the proton conductivity polyelectrolyte film (the U.S. Du Pont make, Nafion 112) which made magnitude of outside \*\* larger 5mm than the above-mentioned electrode, the electrode of a pair was joined with the hotpress so that a catalyst bed might touch an electrolyte film side, and this was made into the electrode electrolyte film zygote (MEA) to them.

[0035] This MEA was put with the separator board and it considered as the configuration of a cell. Creation of a separator board used impregnation and the thing which was stiffened and has improved gas-seal nature and which carried out resin sinking in for the carbon board which carried out cold pressing shaping of the carbon powder material for phenol resin, and formed the gas passageway in this by cutting. The magnitude of a separator is 10cmx20cm, thickness is 4mm, a slot is a crevice with a depth of 1.5mm by width of face of 2mm, and gas circulates this portion. Moreover, the rib section between gas passageways is heights with a width of face of 1mm. Moreover, the manifold hole of oxidizer gas, the manifold hole of fuel gas, and the manifold hole of cooling water were formed in the separator. Moreover, the gas-seal section was formed in a gas circulation way and the surroundings of a manifold hole by the conductive gas-seal agent which made the polyisobutylene distribute conductive carbon.

[0036] To both sides of MEA created as mentioned above, the oxidizer gas circulation side of the rear face of a conductive separator was joined the fuel gas circulation side of the surface of a conductive separator, and it considered as Cell A to them. Moreover, the cooling water circulation side of the rear face of a conductive separator was joined the fuel gas circulation side of the surface of a conductive separator to both sides of MEA, and it considered as Cell B to them.

[0037] Next, it considered as the laminating portion of an unit cell by carrying out the laminating of Cell A and the one every cel of the cells B by turns, and carrying out 50 cel laminating in total.

[0038] The end plate was arranged and concluded to the upper and lower sides of this layered product. At this time, the bonding pressure force at the time of assembly was made into 13 kgf/cm<sup>2</sup>. Thus, the system of a configuration of that the manifold for gas supply discharge was shown in the created cell stack portion at installation and drawing 1 was created.

[0039] This system was operated on condition that the following, the pressure loss in the cell stack portion of fuel gas and the output voltage of the cell unit section were measured, and that result was shown in drawing 2 and drawing 3. In drawing 2 and drawing 3, in the left axis of ordinate, the output voltage of the cell per cell and a right axis of ordinate showed the pressure loss of fuel gas, the horizontal axis showed operation time, and the sampling was performed every 0.1 seconds.

[0040] The temperature of a fuel cell is held at 85 degrees C because a service condition controls the temperature and the flow rate of cooling water. 80% of fuel utilization rates, 40% of ratios of oxygen utilization, and current density 0.2 A/cm<sup>2</sup> consider as common conditions. The result (it considers as conditions 1 below) when humidifying the steam of 80 degrees C of dew-points to fuel gas was shown in drawing 2, and the result (it considers as conditions 2 below) when humidifying the steam of 70 degrees C of dew-points to fuel gas was shown in drawing 3.

[0041] In conditions 1, humidification of fuel gas is excessive and lock out of fuel gas passage checked having generated frequently by connivance in the prior experiment. By lock out of this fuel gas passage, the pressure loss of fuel gas goes up temporarily. And after a fuel gas pressure rises to the pressure which can remove the dew condensation water which blockaded fuel gas passage, fuel gas pressure loss declines. Under the present circumstances, acute fluctuation of a fuel gas pressure as shown in drawing 2 was seen. Moreover, the acute fluctuation same also to the output voltage of a cell as coincidence was seen. Although drawing 2 showed the measurement result for 20 seconds, this acute fluctuation was about generated at intervals of 20 seconds.

[0042] On the other hand, on conditions 2, humidification of fuel gas is proper and fuel gas pressure loss and output voltage show the almost fixed value. It checked having not generated lock out of fuel gas passage in a prior experiment at this time.

[0043] Drawing 4 and drawing 5 show the time subtraction value of the pressure loss of the fuel gas in conditions 1 and conditions 2, and the time subtraction value of the cell output voltage per single cel, respectively. On conditions 1, as shown in drawing 4, the time subtraction value of the pressure loss of fuel gas and the time subtraction value of the cell output voltage per single cel showed the peak in one certain point (at the operation-time 7-second time). Then, the pressure loss of fuel gas and the time subtraction value of a single-cell-voltage output were able to be calculated, and the excess of humidification of fuel gas was able to be detected as well as \*\*\*\* by comparing with the set point which

defined this beforehand. On conditions 2, as shown in drawing 5 , as for the peak of drawing 4 , the pressure loss of fuel gas and the time subtraction value of a single-cell-voltage output were not detected. [0044] Dew condensation water removal actuation is once performed by increasing the delivery fuel gas amount of supply for a signal to the fuel gas feeder 2, or reducing the amount of delivery circulating water flows for a signal to the cooling water control unit 8 by the above methods, or it lowers the amount of delivery humidification for a signal to the fuel gas humidifier 3, when the fuel gas humidification excessive judging machine 5 detects the excess of humidification of fuel gas. This dew condensation water removal actuation is returned to the service condition to need, after continuing until it continues fixed time or detects lack of humidification by the below-mentioned humidification lack detection method, since the excess of humidification is no longer detected by the above-mentioned humidification excessive detection method.

[0045] By usually incorporating the above actuation to operation, lock out of fuel gas passage was able to be removed and stable operation of the polyelectrolyte mold fuel cell 1 was able to be continued.

[0046] Although the case where fuel gas was humidified was explained above, the excess of humidification of oxidizer gas is detectable by establishing the same means as an oxidizer gas side, when humidifying oxidizer gas.

[0047] In addition, \*\*\*\*\* 9 used here is not the indispensable business of operation of this invention. Moreover, as shown in drawing 1 , it considered as the configuration of the fuel gas feeder 2 and another object, but if the fuel gas humidifier 3 is the method which can control the amount of humidification even if it is the configuration of one, it is possible for operation of this invention.

[0048] moreover, time, after equalizing by the method which defined the physical quantity for an input beforehand and removing a single-engined noise -- difference -- it cannot be overemphasized that a value or a time differential value can be calculated.

[0049] (Example 2) Next, the 2nd example of this invention is explained with reference to a drawing.

[0050] Drawing 6 is the conceptual diagram showing the fuel cell structure of a system which is the 2nd example of this invention. The fuel cell system of this example is the same as the system of the above-mentioned example 1 except the fuel gas humidification lack detecting element 11 being added.

[0051] Drawing 7 and drawing 8 show time amount progress of the pressure loss in the cell stack portion of fuel gas. The result (it considers as conditions 4 below) when drawing 8 humidifies the steam of 65 degrees C of dew-points for a result when drawing 7 humidifies the steam of 70 degrees C of dew-points to fuel gas (it considers as conditions 3 below) to fuel gas was shown. Conditions other than this presupposed that it is the same as that of an example 1.

[0052] In drawing 7 and drawing 8 , it found out that the pressure loss of fuel gas became small, so that there were few amounts of humidification, when conditions 3 were compared with conditions 4. Therefore, when less than it as compared with the set point which defined fuel gas pressure loss beforehand, it can be judged that humidification of fuel gas is insufficient. Since the pressure loss of fuel gas changes with fuel gas flow rates besides the amount of humidification, it is necessary to calculate said set point as a function of a fuel gas flow rate and the amount of humidification or, it needs to change a fuel gas flow rate and the amount of humidification, and it is necessary to measure it in advance.

[0053] In the above, the 2nd example of this invention was explained. Although the polyelectrolyte mold fuel cell equipment in the case of humidifying fuel gas was explained here, the lack of humidification of oxidizer gas is detectable by establishing the same means as an oxidizer gas side, when humidifying oxidizer gas.

[0054]

[Effect of the Invention] As mentioned above, the polyelectrolyte mold fuel cell of this invention and its operating method are controlling without making the amount of humidification of fuel gas and oxidizer gas into the excess of humidification, and make possible continuous running by which the polyelectrolyte mold fuel system was stabilized.

[Translation done.]